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Forest Development Research

PROGRAM

ENVIRONMENTAL PROTECTION

Manning Diversified Forest Products
Research Trust Fund
MDFP17/96

Wood By-Products Project - Soil Amendment Experiments Update 1997/98

December 1997

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Table of Contents

General Project Description ---------- 3

Proposed Work Plan ---------- 4

1997 Greenhouse Trial Procedures and Results ---------- 5

Information for Greenhouse Trial Treatments ---------- 6

Greenhouse Trial Treatment Tables ---------- 8

Greenhouse Trial Methodology ---------- 9

A. Brome Section ---------- 9

B. Alfalfa Section ---------- 10

C. Greenhouse Interim Trial Measurements ---------- 10

D. Post Greenhouse Trial
Soil/Residue Mixture Analysis ---------- 10

1997 Field Plot Design and Results (to date) ---------- 18

Fairview College
Mill By - Product Project

Mill By-Product Project

General Project Description

In 1994, Manning Diversified Forest Products (MDFP) and Fairview College embarked upon a mill by-product (hog fuel) project that was designed to test - demonstrate the feasibility of applying hog fuel to agricultural land as a soil amendment and as a means of avoiding incineration of this material.

Our initial trial site at Manning consisted of nine treated one acre plots (three levels of by-product, three levels of fertilizer) plus control plots with barley being the test crop. Smaller replicate trial plots were established at Fairview on the College farm.

The rates of mill by-product used at Manning were quite high, and crop growth was very poor in all the treated plots relative to the controls. As a result, the Manning site was discontinued and the smaller plots at Fairview were maintained with additional small plots being established using much lower rates of by-product. Those plots have been maintained to date and evaluated annually.

In the winter of 1996-97, Fairview College organized a meeting (at Fairview) with MDFP, Ainsworth, Canfor, Daishowa and Alberta Economic Development and Tourism(D.E.T.&T.). This meeting generated the present project with initially four organizations involved i.e. MDFP, Ainsworth, D.E.T. &T and Fairview College. In the summer of 1997 , Canfor joined the group.

As a result of the winter meeting, a number of avenues of mill by-product use were discussed. The soil amendment section proceeded with three goals in year one i.e. characterization of the by-products, a greenhouse trial in early spring 1997 to be followed in the summer of 1997 with field trials near the mill operational sites.

Mill by-products were characterized by the Alberta Research Council (ARC) (see attached) prior to the greenhouse trials and the various soil - by-products - fertilizer - crop treatments were also designed by ARC. The greenhouse trials (see attached) were carried out at the Woodmere (forestry seedling) greenhouse in Fairview and were completed in early June 1997. Plant tissues and soils were collected, dried and sent to ARC for analysis which is at present being completed.

The field trials were initiated in June of 1997 near each company's site on a farmer cooperators property. The treatment setups for each trial are enclosed. The Ainsworth and MDFP plots were established in June - July 1997 and the Canfor plots in August 1997. The early seeded plots were evaluated in early September 1997, the results of which are enclosed.

Mill By-Product Project

1997 Greenhouse Trial Procedures and Results (to date)

INFORMATION FOR GREENHOUSE TRIAL TREATMENTS

The characterization data pertinent to the February 21 set of residue samples received and the two soils received last November was used for establishing the treatments.

Soil 1 = 0 to 15 cm depth of clay soil
Soil 2 = 0 to 15 cm depth of sandy soil
Mixtures are to be made up of dry soil and wet or as is waste.

1. Ainsworth Wood Chips, Ainsworth Hog Fuel, Manning Hog Fuel

   Rate 1 = equivalent of 1/6 or 2.5 cm of a 15 cm surface soil or 2.5 cm of residue incorporated into top 15 cm layer of soil.

   Rate 2 = equivalent of 1/3 or 5 cm of a 15 cm surface soil or 5 cm of residue incorporated into top 15 cm of soil.

   Fertilizer additions are based on achieving a C/N ratio of 15 and a flat rate for all treatments - including controls that might be used for crop production in the area.

   Water addition is based on field capacity values for the soils.

   All weights including soil, water, and total weight do not include the weight of the pot.

2. DMI Topping Soil

   Rate 1 = equivalent of ¼ of a 15 cm layer of soil or about 3.75 cm of material incorporated into top 15 cm of soil.

   Rate 2 = equivalent of ½ of a 15 cm surface layer of soil or about 7.5 cm of material incorporated into top 15 cm of soil.

   Fertilizer addition and water addition based on same approach as the above materials.

3. Ainsworth Ash

   Rate 1 = Addition of ash to achieve soil/ash mix pH of 8.

   Rate 2 = Addition of ash to achieve soil/ash mix pH of 9.

   Fertilizer addition and water addition based on same approach as above.

4. General Guidelines

a) The waste and soil materials weighed and appropriate mixes prepared and placed in plastic bag lined pots.
b) The recommended fertilizer amounts are to be dissolved in the water or a portion thereof that is added.
c) When the pot mixes have been prepared and fertilizer/water have been added wait about 2 days before seeding.

By-Product Type	Soil	Waste Vol (cm^3 wet/pot)			Waste Weight(g wet/pot			Soil Weight (g dry/pot)			Water Weight (g/pot)			Total wt(g/pot		
		Control	Rate 1	Rate 2	Control	Rate 1	Rate 2	Control	Rate 1	Rate 2	Control	Rate 1	Rate 2	Control	Rate 1	Rate 2
Ainsworth Hog Fuel	1	0	400	800	0	51	102	3120	2600	2080	718	639	560	3838	3290	2742
Ainsworth Hog Fuel	2	0	400	800	0	51	102	3120	2600	2080	312	301	290	3432	2952	2472
Ainsworth Wood Chips	1	0	400	800	0	37	73	3120	2600	2080	718	627	537	3838	3264	2690
Ainsworth Wood Chips	2	0	400	800	0	37	73	3120	2600	2080	312	289	267	3432	2926	2420
Ainsworth Ash	1	0	400	800	0	20	50	3120	2600	2080	718	614	518	3838	3234	2648
Ainsworth Ash	2	0	400	800	0	40	100	3120	2600	2080	312	292	288	3432	2932	2468
Manning Hog Fuel	1	0	400	800	0	116	232	3120	2600	2080	718	691	664	3838	3406	2975
Manning Hog Fuel	2	0	400	800	0	116	232	3120	2600	2080	312	353	393	3432	3068	2705
DMI Topping Soil	1	0	400	800	0	332	664	3120	2600	2080	718	864	1010	3838	3796	3754
DMI Topping Soil	2	0	400	800	0	332	664	3120	2600	2080	312	526	739	3432	3458	3484

By-Product Type	Soil	N added(g/pot)			P Added(g/pot)			12-51-0 Added(g/pot)			34-0-0 Added((g/pot)		
		Control	Rate 1	Rate 2	Control	Rate 1	Rate 2	Control	Rate 1	Rate 2	Control	Rate 1	Rate 2
Ainsworth Hog Fuel	1	0.16	1.55	3.09	0.02	0.15	0.31	0.07	0.68	1.36	0.43	4.3	8.61
Ainsworth Hog Fuel	2	0.16	1.55	3.09	0.02	0.15	0.31	0.07	0.68	1.36	0.43	4.3	8.61
Ainsworth Wood Chips	1	0.16	[illegible]	2.31	0.02	0.12	0.23	0.07	0.54	1.02	0.43	3.44	6.44
Ainsworth Wood Chips	2	0.16	1.23	2.31	0.02	0.12	0.23	0.07	0.54	1.02	0.43	3.44	6.44
Ainsworth Ash	1	0.16	0.43	1.08	0.02	0.04	0.11	0.07	0.19	0.48	0.43	1.2	3.01
Ainsworth Ash	2	0.16	0.86	2.16	0.02	0.09	0.22	0.07	0.38	0.95	0.43	2.41	6.02
Manning Hog Fuel	1	0.16	3.55	7.11	0.02	0.36	0.71	0.07	1.57	3.14	0.43	9.9	19.79
Manning Hog Fuel	2	0.16	3.55	7.11	0.02	0.36	0.71	0.07	1.57	3.14	0.43	9.9	19.79
DMI Topping Soil	1	0.16	4.29	8.57	0.02	0.43	0.86	0.07	1.89	3.78	0.43	11.94	23.87
DMI Topping Soil	2	0.16	4.29	8.57	0.02	0.43	0.86	0.07	1.89	3.78	0.43	11.94	23.87

Greenhouse Trial Treatments

Greenhouse Trials Methodology

A. Brome Section

Soil was dried and then sieved through a 6 ½ 64ths screen. (Clay was first crushed by placing in clean fiberglass seed bags and running over with a tractor.) Ingredient make-ups for each pot were calculated by ARC. Amounts for each pot were weighed and placed in double plastic bags. Additives were weighed, placed in bags with the soil and mixed in. Bags and soil were placed in plastic pots. Water for each pot was weighed in beaker and weighed amount of each type of fertilizer was mixed into the water. This mixture was then poured into the pot. The pots were then weighed and their total weight recorded on their label. After two or three days the soil in each pot was stirred to a depth of about 5 cm. Then about 1cm of soil was removed from the top of each pot and a weighed amount of seed (.42 grams or about 75 seeds) sprinkled on the surface and covered with the removed soil. Every day or two thereafter, depending on conditions, the water level was brought back up to the original weight in all the pots. When the plants became much taller and conditions much drier it was necessary to exceed this amount in some pots to ensure they did not wilt from one day to the next.

All brome was planted either April 1 or 2. At this time it was felt that the pots containing Manning Hog Fuel and particularly DMI Topping contained too much water. They were dried down a little and planted anyway but the germination was very poor. Therefore they were gradually dried down and a new more reasonable water amount established. The Manning Hog Fuel was then replanted April 18, and DMI Topping April 22.

Pots were arranged completely randomly in the area prepared for them. At every watering they were moved one row over in an organized fashion to eliminate the possibility of their placement affecting the results.

Germination was estimated by roughly counting the number of seedlings and then rounding to the nearest 5.

Height was estimated by roughly averaging the height of three randomly gathered clumps of about 10 plants from each pot. This estimate was rounded to the nearest 5.

Harvesting was done by cutting all the plants in each pot about 2 cm from the soil surface and placing them in a paper bag for drying.

Germination for the controls and Ainsworth-brome pots was done April 12 and May 8. Height 1 was taken April 28, and Height 2 was taken June 8. Harvesting of the Ainsworth-brome pots was done June 9.

Germination for the Manning-brome pots was done May 15, and Height 1 taken June 6, Height 2 June 19 and harvesting was done June 19.

Germination for the DMI-brome pots was done May 19, and Height 1 taken June 8, Height 2 June 19 and harvesting was done June 19.

B. Alfalfa Section

All alfalfa was planted in soil #2 (sandy). All were planted in rate 1 mixtures for the various additives tested and rate 1 for the 12-51-0 fertilizer. No 34-0-0 fertilizer was added. The seed was inoculated before planting. Seed was sprinkled on the surface and covered with 1 cm of the previously removed soil. Seed was not weighed or counted but simply thinned after germination to 6 plants in each pot.

The Alfalfa was planted April 4, Height 1 taken April 28, Height 2 taken June 19 and harvesting was done June 19.

Soil #1 - heavy clay
Soil #2 - light sandy

C. Greenhouse Interim Trial Measurements (pages 11 - 17)

AHF - Ainsworth Hog Fuel
AWC - Ainsworth Wafer Chips
AA - Ainsworth Ash
MHF - Manning Hog Fuel
DMI - Daishowa Topping Soil
C - Control

D. Post Greenhouse Trial vegetation and soil analysis is ongoing at Alberta Research Council. These include measurements of:

1) Total carbon
2) Total nitrogen, available nitrogen
3) pH (H_2O and $CaCl_2$)
4) Saturated paste extract properties (Ainsworth ash and DMI topping treatments only)
5) Calcium carbonate equivalent (Ainsworth ash and DMI topping treatments only)
6) Elemental analysis of plant tissue.

Greenhouse Trial Measurements
Ainsworth Hog Fuel

Additive	Level	Pot #	Pot Mass	Adj Pot Mass	Soil Type	Fert. Rate	Germ A	Germ B	Water Used	Height 1	Height 2
AHF	1	1	3360		1	1	60+	70	481	26	40
AHF	1	2	3367		1	1	50+	60	370	23	40
AHF	1	3	3355		1	1	60+	65	470	22	45
AHF	1	4	3373		1	2	30+	50	432	19	50
AHF	1	5	3361		1	2	50+	55	458	23	45
AHF	1	6	3376		1	2	50+	60	439	19	45
AHF	2	10	3032		1	1	25	40	417	14	35
AHF	2	11	3040		1	1	40	50	366	14	35
AHF	2	12	3059		1	1	35	55	400	11	30
AHF	2	7	3040		1	2	3	5	373	12	35
AHF	2	8	3042		1	2	0	5	395	8	15
AHF	2	9	3034		1	2	0	5	361	5	25
AHF	1	13	2826	2976	2	1	40	50		11	40
AHF	1	14	2827	2977	2	1	40	60	332	20	40
AHF	1	15	2822	2972	2	1	50	50	373	17	35
AHF	1	16	2827	2977	2	2	14	40	306	14	40
AHF	1	17	2825	2975	2	2	15	45	320	12	45
AHF	1	18	2829	2979	2	2	30	50	452	18	45
AHF	2	22	2568		2	1	25	40	293	8	20
AHF	2	23	2566		2	1	19	40	358	9	25
AHF	2	24	2564		2	1	40	45	320	8	30
AHF	2	19	2571		2	2	2	10	386	6	20
AHF	2	20	2575		2	2	0	2	406	5	25
AHF	2	21	2570		2	2	0	5		5	20

Greenhouse Trial Measurements
Manning Hog Fuel

dditive	Level	Pot #	Pot Mass	Adj Pot Mass	Soil Type	Fert. Rate	Germ A	Germ B	Water Used	Height 1	Height 2
MHF	1	28	3491	3380	1	1	65			25	35
MHF	1	29	3497	3380	1	1	50			25	35
MHF	1	30	3497	3380	1	1	55			25	35
MHF	1	25	3509	3380	1	2	50			20	30d
MHF	1	26	3512	3380	1	2	50			25	25d
MHF	1	27	3510	3380	1	2	50			25	25d
MHF	2	34	3144	3042	1	1	25			10	20
MHF	2	35	3147	3042	1	1	50			10	20d
MHF	2	36	3149	3042	1	1	55			15	20
MHF	2	31	3161	3042	1	2	20			10	17d
MHF	2	32	3158	3042	1	2	10			5	10d
MHF	2	33	3164	3042	1	2	20			10	20d
MHF	1	43	3065	2932	2	1	60			25	35
MHF	1	44	3001	2932	2	1	55			30	40
MHF	1	45	3066	2932	2	1	50			30	40
MHF	1	46	3082	2932	2	2	30			15	20d
MHF	1	47	3079	2932	2	2	60			15	25d
MHF	1	48	3074	2932	2	2	40			25	30d
MHF	2	37	2671	2562	2	1	30			15	25
MHF	2	38	2791	2612	2	1	65			15	25
MHF	2	39	2780	2612	2	1	45			15	20
MHF	2	40	2749	2612	2	2	15			10	15d
MHF	2	41	2799	2612	2	2	15			10	10d
MHF	2	42	2802	2612	2	2	25			10	15d

d = some dying

Greenhouse Trial Measurements
Diashowa Topping Soil

Additive	Level	Pot #	Pot Mass	Adj Pot Mass	Soil Type	Fert. Rate	Germ A	Germ B	Water Used	Height 1	Height 2
DMI	1	52	3878	3600	1	1	60			25	35
DMI	1	53	3879	3600	1	1	60			25	30
DMI	1	54	3876	3600	1	1	50			25	35
DMI	1	49	3894	3600	1	2	35			15	25d
DMI	1	50	3894	3600	1	2	35			20	30d
DMI	1	51	3884	3600	1	2	35			20	25d
DMI	2	58	3549	3250	1	1	55			15	25
DMI	2	59	3548	3250	1	1	20			15	25
DMI	2	60	3550	3250	1	1	45			15	20
DMI	2	55	3555	3250	1	2	5			10	20d
DMI	2	56	3559	3250	1	2	15			15	15d
DMI	2	57	3556	3250	1	2	10			10	15d
DMI	1	71	3842	3250	2	1	15			15	30d
DMI	1	72	3837	3250	2	1	50			25	35
DMI	1	73	3834	3250	2	1	60			25	40
DMI	1	68	3845	3250	2	2	30			15	25d
DMI	1	70	3850	3250	2	2	35			20	30d
DMI	1	69	3808	3250	2	2	60			30	45
DMI	2	61	3568	2950	2	1	35			15	25
DMI	2	62	3566	2950	2	1	35			15	25
DMI	2	63	3567	2950	2	1	55			15	25
DMI	2	64	3584	2950	2	2	20			15	15d
DMI	2	65	3582	2950	2	2	5			10	15d
DMI	2	66	3586	2950	2	2	20			10	15d

d = some dying

Greenhouse Trial Measurements
Ainsworth Wafer Chips

Additive	Level	Pot #	Pot Mass	Adj Pot Mass	Soil Type	Fert. Rate	Germ A	Germ B	Water Used	Height 1	Height 2
AWC	1	110	3345		1	1	60	55	369	26	40
AWC	1	111	3338		1	1	50	60	417	26	40
AWC	1	112	3346		1	1	50	60	364	25	45
AWC	1	107	3351		1	2	40	50	383	22	40
AWC	1	108	3352		1	2	40	60	354	23	45
AWC	1	109	3342		1	2	40	55	398	20	45
AWC	2	101	3013		1	1	20	45	435	18	40
AWC	2	102	3027		1	1	18	30	351	17	40
AWC	2	103	3022		1	1	30	50	395	20	45
AWC	2	104	3018		1	2	10	20	435	17	30
AWC	2	105	3019		1	2	7	15	328	10	30
AWC	2	106	3025		1	2	10	20	339	12	30
AWC	1	122	2782		2	1	40	55	216	21	40
AWC	1	123	2774		2	1	40	55	374	24	35
AWC	1	124	2771		2	1	50	50	221	24	35
AWC	1	119	2776		2	2	25	40	233	21	40
AWC	1	120	2733		2	2	25	50	224	20	40
AWC	1	121	2786		2	2	40	60	210	21	45
AWC	2	113	2511		2	1	25	45	312	13	35
AWC	2	114	2515		2	1	25	30	322	14	35
AWC	2	115	2511		2	1	35	40	287	15	35
AWC	2	116	2518		2	2	10	15	312	11	35
AWC	2	117	2514		2	2	10	25	266	12	35
AWC	2	118	2514		2	2	5	25	314	13	30

Greenhouse Trial Measurements
Ainsworth Ash

Additive	Level	Pot #	Pot Mass	Adj Pot Mass	Soil Type	Fert. Rate	Germ A	Germ B	Water Used	Height 1	Height 2
AA	1	143	3319		1	1	60	65	555	21	35
AA	1	144	3312		1	1	60	70	531	23	35
AA	1	145	3308		1	1	60	75	478	20	35
AA	1	146	3317		1	2	60	65	411	23	40
AA	1	147	3322		1	2	60	65	483	25	40
AA	1	148	3321		1	2	60	65	401	23	40
AA	2	128	3019		1	1	30	65		14	35
AA	2	129	3029		1	1	20	50		14	35
AA	2	131	3019		1	1	40	55	229	11	35
AA	2	125	3028		1	2	0	25	359	8	25
AA	2	126	3029		1	2	1	20	380	8	25
AA	2	127	3021		1	2	0	20		8	25
AA	1	137	2729		2	1	60	65	434	22	35
AA	1	138	2735		2	1	60	70	303	29	35
AA	1	139	2731		2	1	50	60	381	27	35
AA	1	140	2738		2	2	50	55	405	23	40
AA	1	141	2728		2	2	60	70	462	18	40
AA	1	142	2731		2	2	50	60	409	19	45
AA	2	134	2564		2	1	50	70	375	24	30
AA	2	135	2561		2	1	60	65	383	19	35
AA	2	136	2562		2	1	40	60	367	19	35
AA	2	130	2564		2	2	0	20	203	6	25
AA	2	132	2566		2	2	0	20	342	9	20
AA	2	133	2568		2	2	0	20	348	7	20

Greenhouse Trial Measurements
Control Group

Additive	Level	Pot #	Pot Mass	Adj Pot Mass	Soil Type	Fert. Rate	Germ A	Germ B	Water Used	Height 1	Height 2
C		67			1		60	70	495	19	30
C		90			1		60	70	390	18	35
C		91			1		60	75	563	18	30
C		92			1		60	75	461	23	30
C		93			1		60	70	449	20	35
C		94			1		60	70	458	17	30
C		95			1		60	70	479	19	35
C		97			1		60	65	361	19	30
C		98			1		60	70	491	20	30
C		99			1		60	65	568	21	30
C		161			1		60	75	432	21	30
C		100			1		60	70	380	21	30
C		149			2		60	70	534	22	25
C		150			2		60	65	578	25	30
C		151			2		60	65	493	22	25
C		152			2		60	65	575	24	30
C		153			2		60	70	570	25	25
C		154			2		50	75	571	22	25
C		155			2		50	75	519	23	25
C		156			2		60	70	397	28	30
C		157			2		60	65	546	25	25
C		158			2		60	70	503	25	25
C		159			2		60	65	475	26	25
C		160			2		60	75	442	24	25

Water Use Summary Sheet

Additive	Soil Type	Level	Fert. Level	Ave. Germ	Ave Growth	Ave. Water Used One WK	Ave. Water Used One WK
AA	Clay	1	1	70	21	477(6)	
		1	2	65	24		
		2	1	56	13	323(3)	425
		2	2	22	8		
	Sand	1	1	65	26	399(6)	
		1	2	62	20		
		2	1	65	21	336(6)	367
		2	2	20	7		
AHF	Clay	1	1	65	24	442(6)	
		1	2	55	20		
		2	1	48	13	385(6)	414
		2	2	6	8		
	Sand	1	1	53	16	357(5)	
		1	2	45	15		
		2	1	42	8	353(5)	355
		2	2	6	5		
AWC	Clay	1	1	58	26	381(6)	
		1	2	55	22		
		2	1	42	18	381(6)	381
		2	2	18	13		
	Sand	1	1	53	23	246(6)	
		1	2	50	21		
		2	1	38	14	302(6)	274
		2	2	22	12		
Control	Clay	n/a	n/a	70	20	460(12)	
	Sand	n/a	n/a	69	24	516(12)	

Mill By-Product Project

1997 Field Plot Design and Results (to date)

Results

1. Crop Height (cm)

2. Colour 1-9 (1 →light green
   9 → dark green)

3. General Appearance 1- 9
   (1 → poor, 9 → excellent)

B1

16 (3)	4 (6)	0 (9)
20 (2)	2 (5)	12 (8)
0 (1)	0 (4)	8 (7)

B2

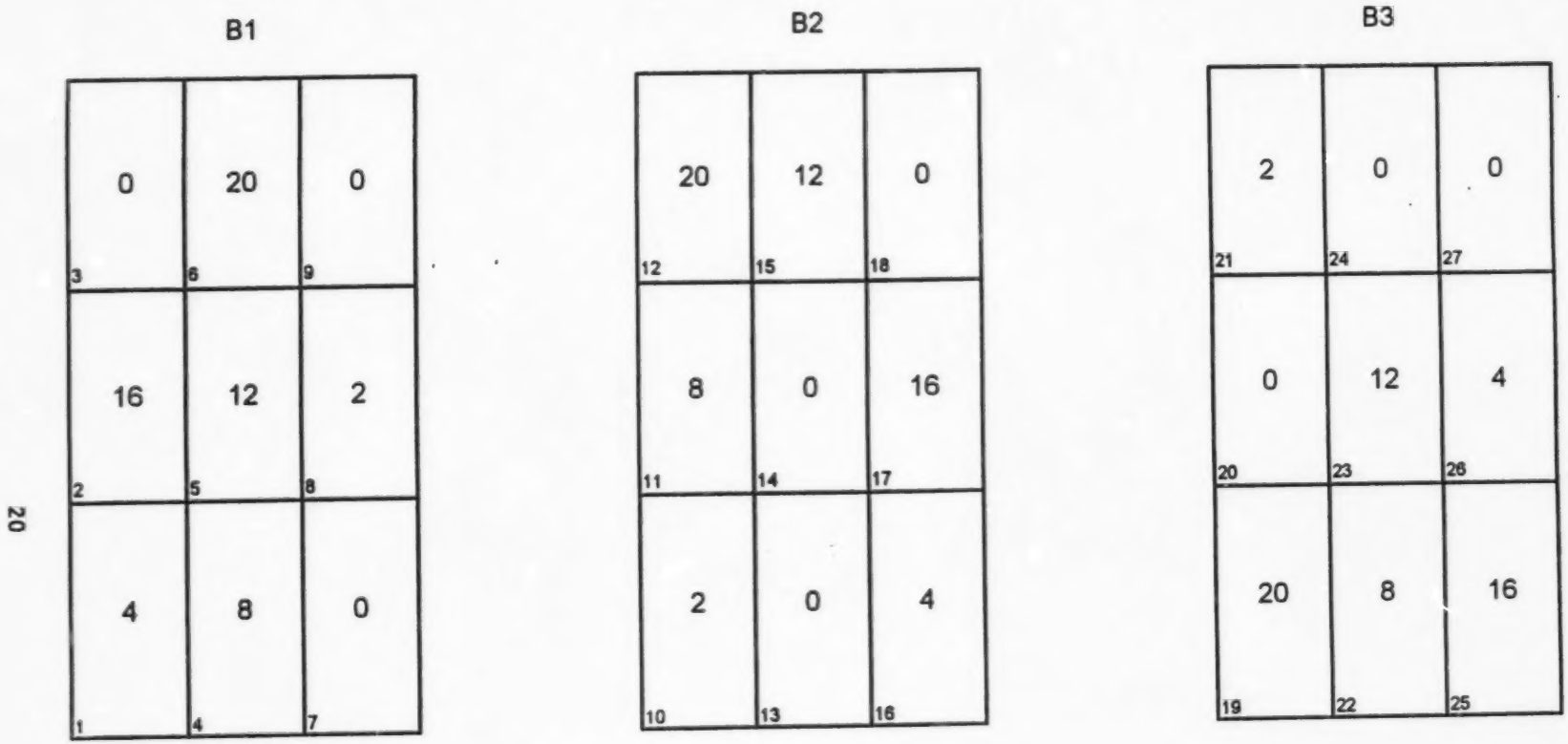
8 (12)	0 (15)	12 (18)
20 (11)	0 (14)	4 (17)
2 (10)	0 (13)	16 (16)

B3

4 (21)	12 (24)	0 (27)
16 (20)	8 (23)	20 (26)
0 (19)	0 (22)	2 (25)

MDFP Trial # 1 Hog Fuel - Barley/Brome

Rate in Tonnes/ha



MDFP Trial # 2 Hog Fuel - Barley/Alfalfa

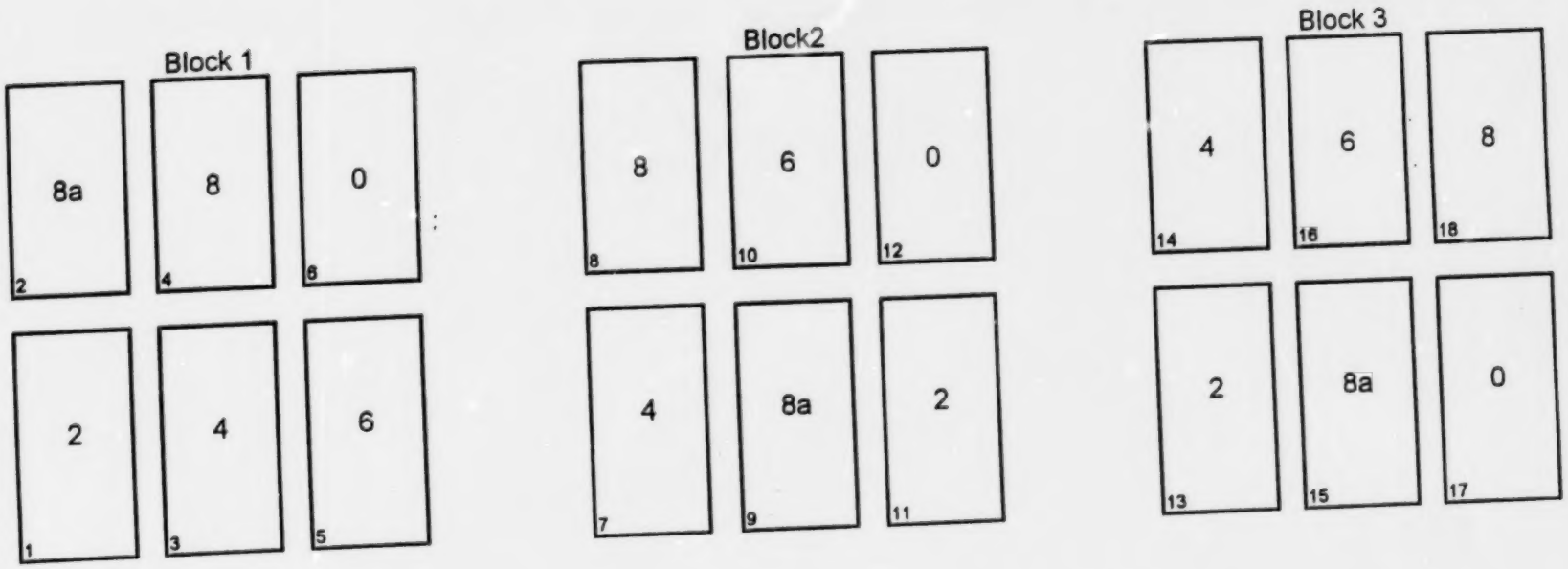
Rate in Tonnes/ha

Trial #4	Trial #5	Trial # 6
Heavy Soil	Heavy Soil	Heavy Soil
STRANDS	SAWDUST	ASH

B U S H

Trial #1	Trial # 2	Trial #3
Light Soil	Light Soil	Light Soil
STRANDS	SAWDUST	ASH

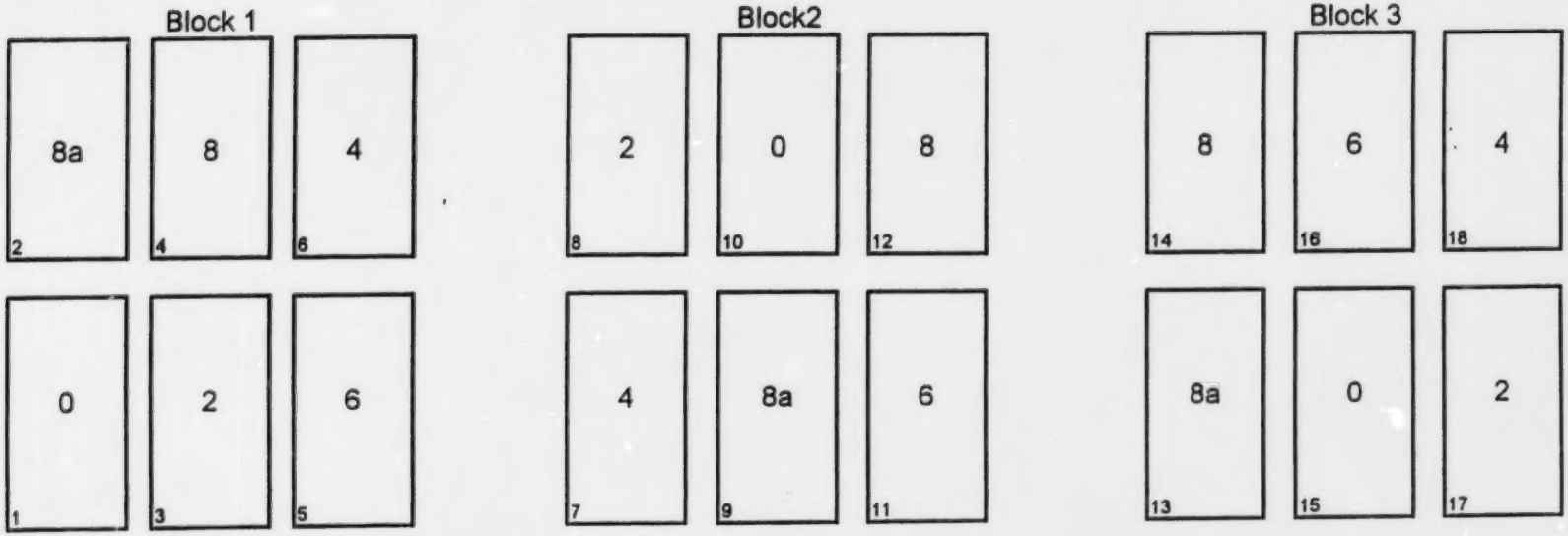
Ainsworth Project



Ainsworth

Trial #1 - STRANDS - light soil - Barley/Brome

- rates in tonnes/acre
- established July 8-9, 1997

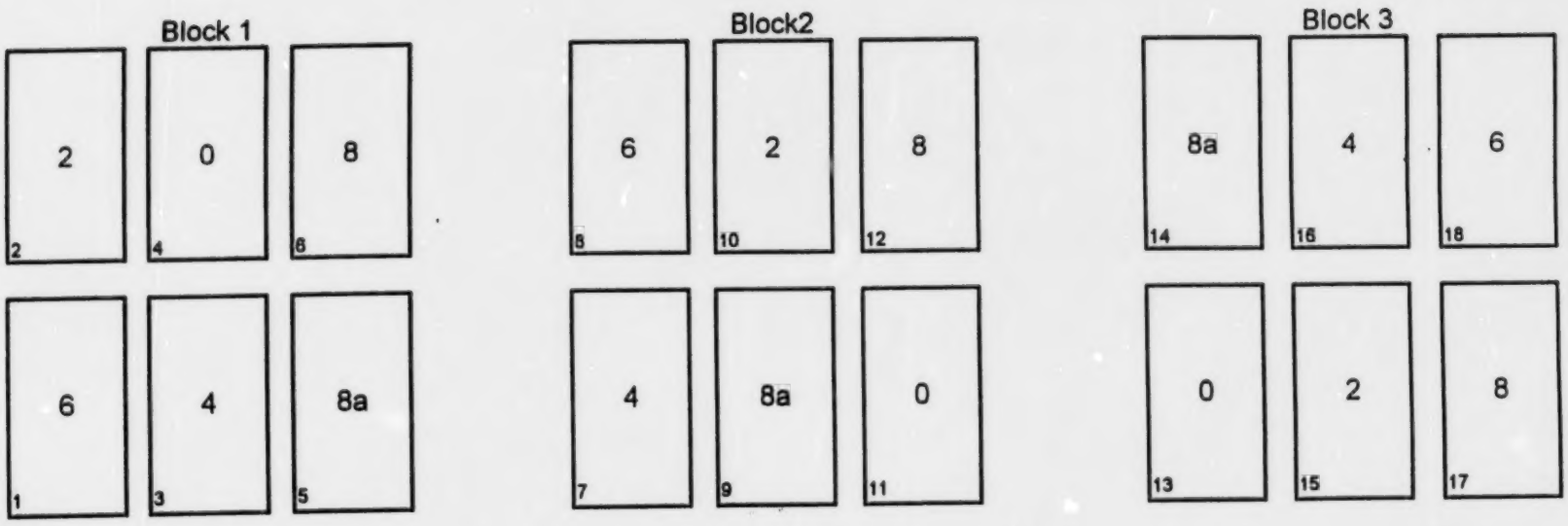


Ainsworth

Trial #2 - SAWDUST/resin - light soil - Barley/Brome

- rates in tonnes/acre

- established July 8-9, 1997

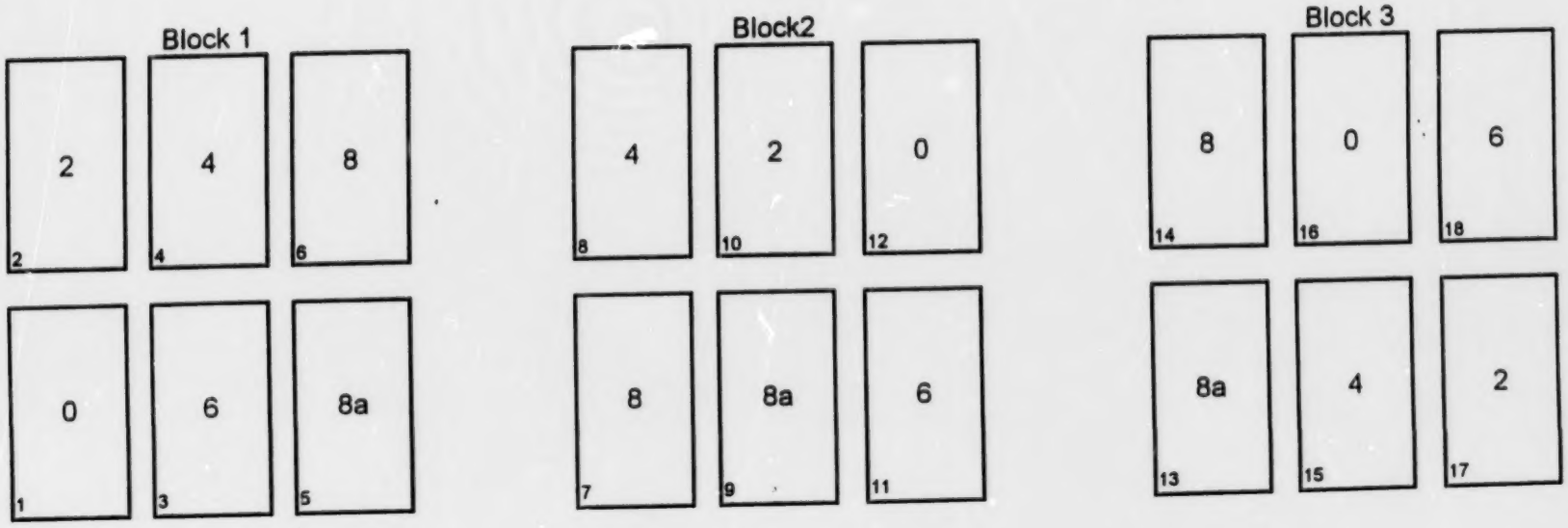


Ainsworth

Trial #3 - ASH - light soil - Barley/Brome

- rates in tonnes/acre

- established July 8-9, 1997

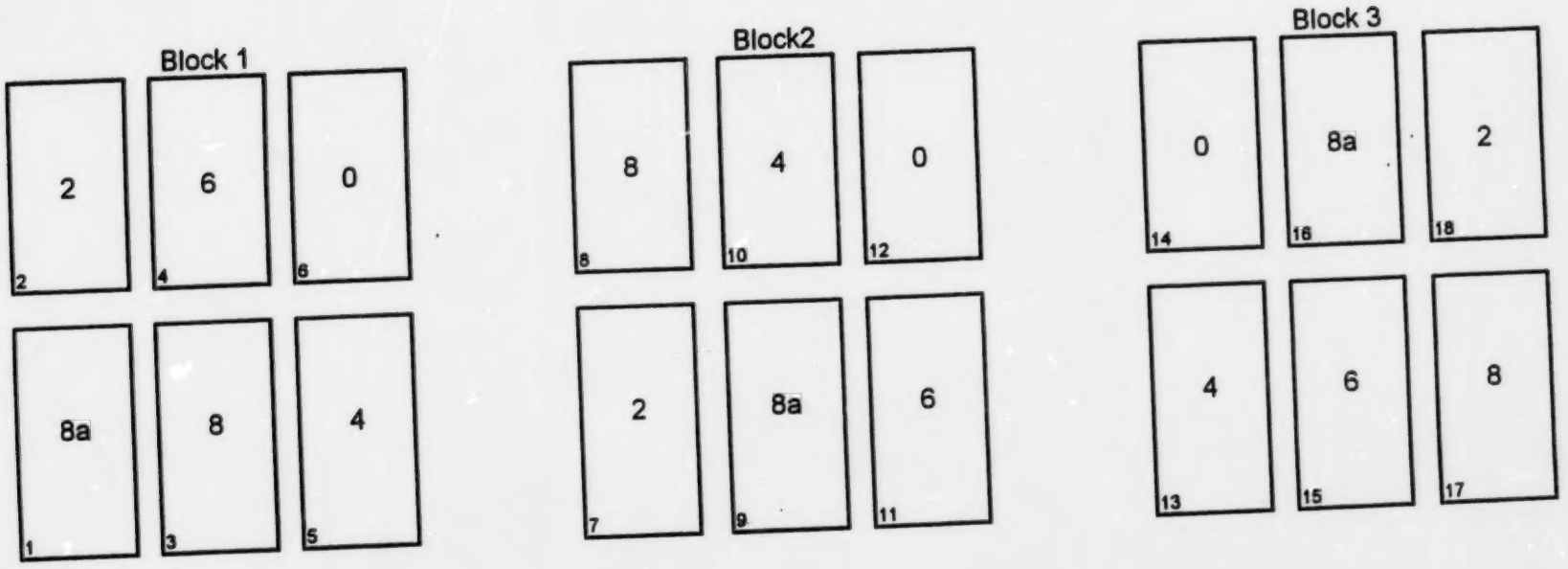


Ainsworth

Trial #4 - STRANDS - heavy soil - Barley/Brome

- rates in tonnes/acre

- established July 8-9, 1997

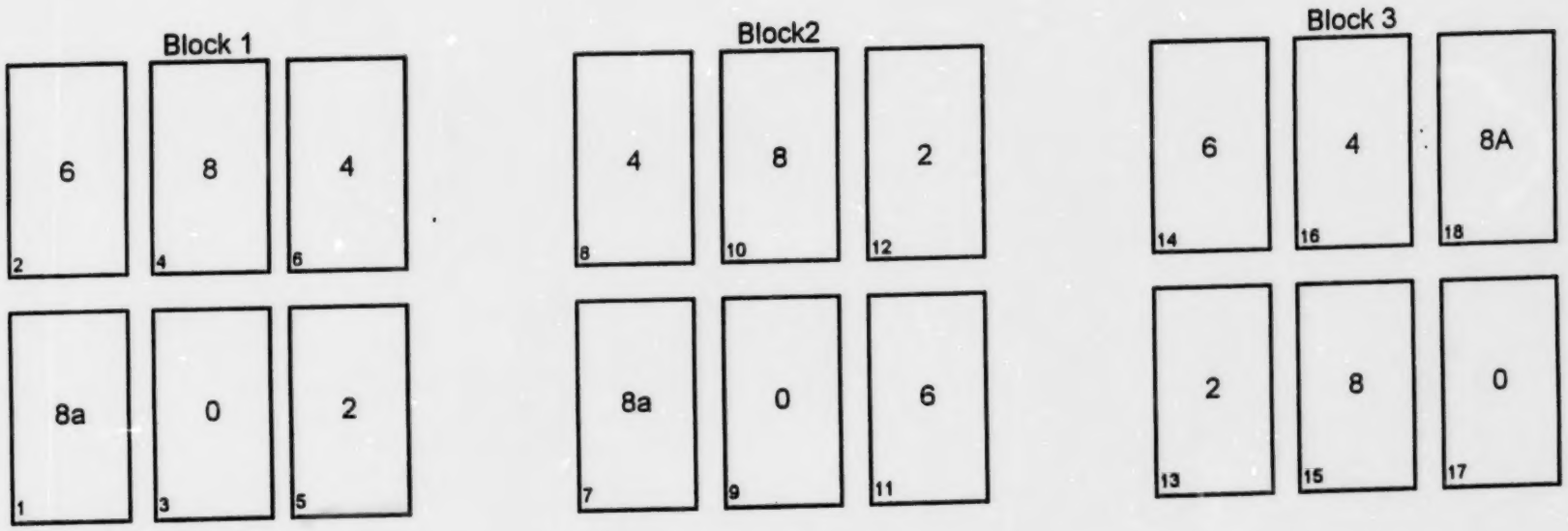


Ainsworth

Trial #5 - SAWDUST/resin - heavy soil - Barley/Brome

- rates in tonnes/acre

- established July 8-9, 1997



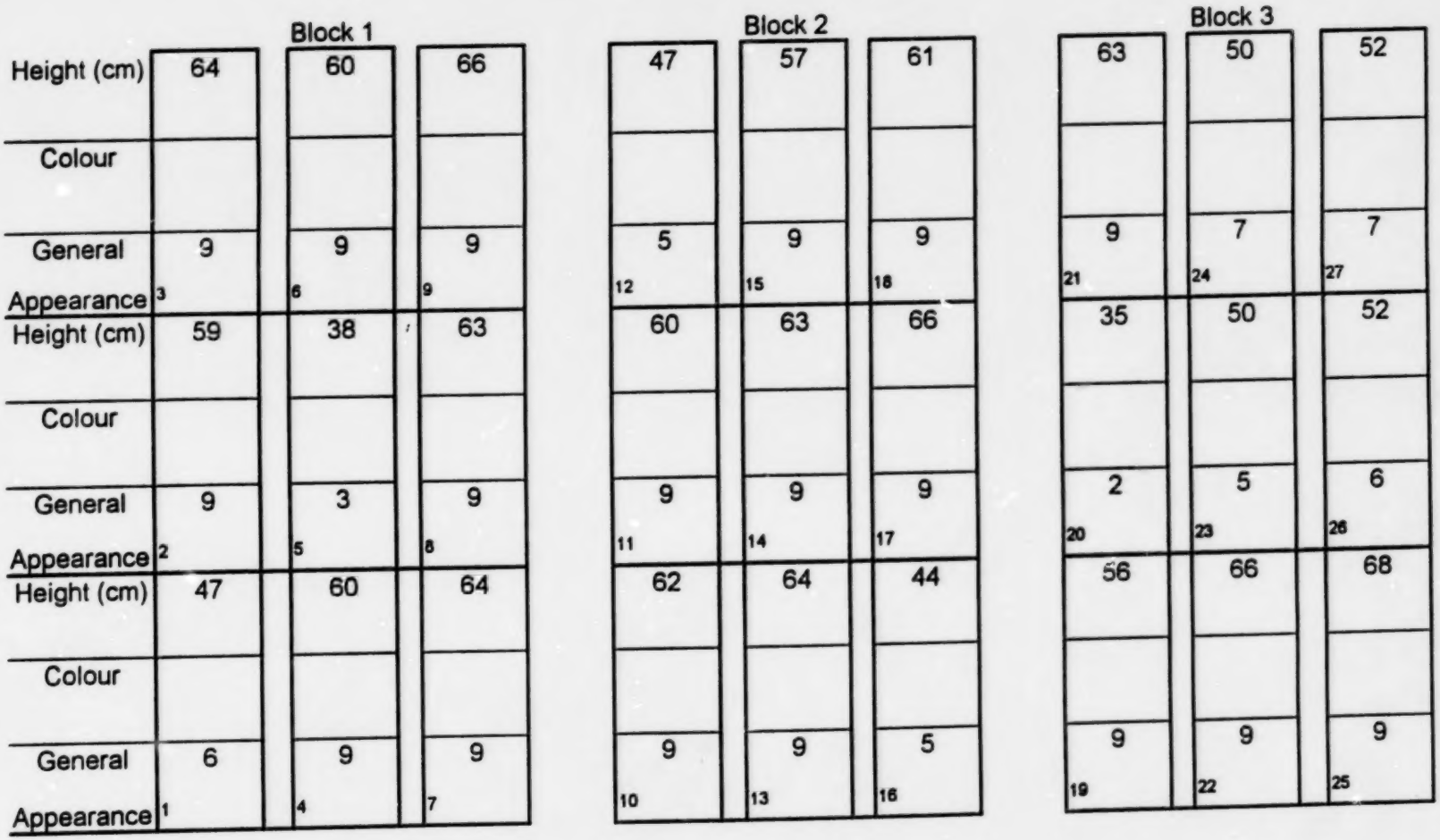
Ainsworth

Trial #6 - ASH - heavy soil - Barley/Brome

- rates in tonnes/acre

- established July 8-9, 1997

Results (to date)



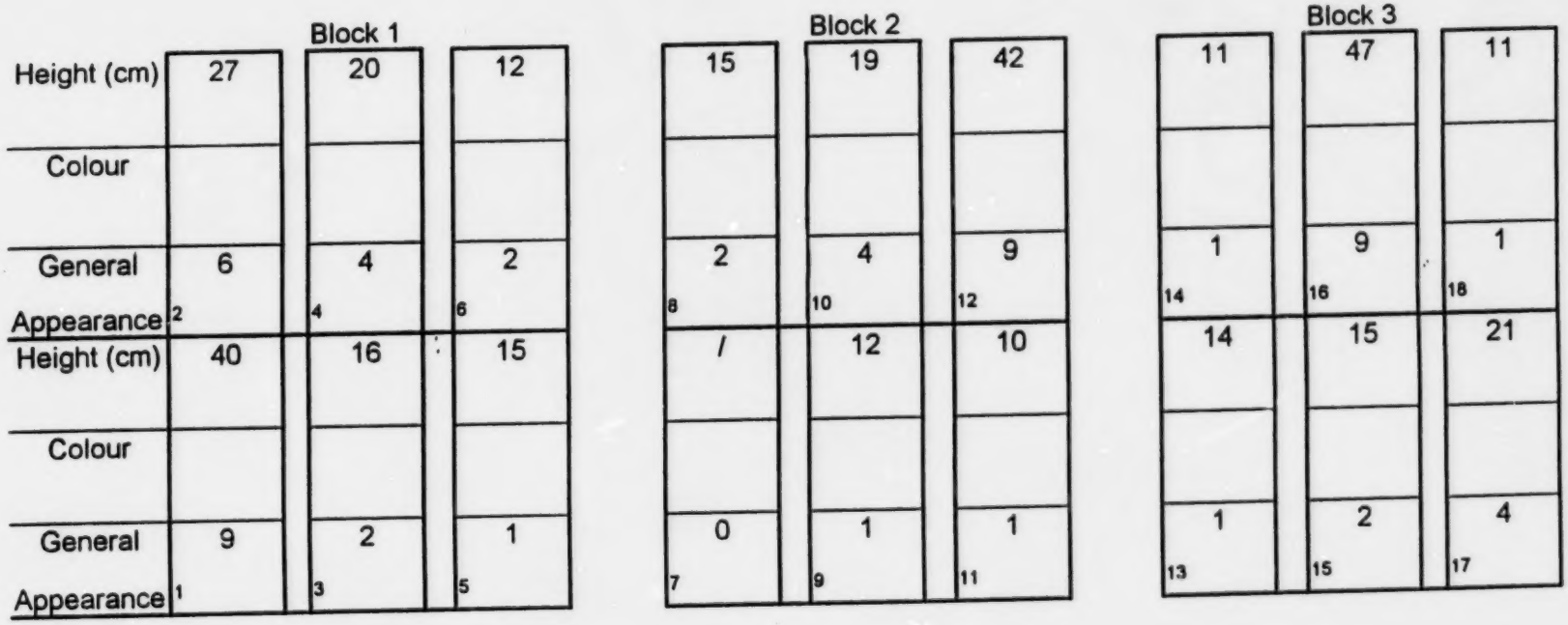
MDFP - Barley/Brome

	Block 1		
Height (cm)	52	32	48
Colour			
General Appearance	7 [3]	1 [6]	7 [9]
Height (cm)	40	36	50
Colour			
General Appearance	3 [2]	2 [5]	7 [8]
Height (cm)	62	65	64
Colour			
General Appearance	9 [1]	9 [4]	9 [7]

	Block 2		
	30	41	58
	1 [12]	3 [15]	9 [18]
	55	62	46
	8 [11]	9 [14]	4 [17]
	61	51	45
	9 [10]	7 [13]	4 [16]

	Block 3		
	49	66	65
	7 [21]	9 [24]	9 [27]
	60	44	65
	9 [20]	6 [23]	9 [26]
	37	40	34
	2 [19]	2 [22]	2 [25]

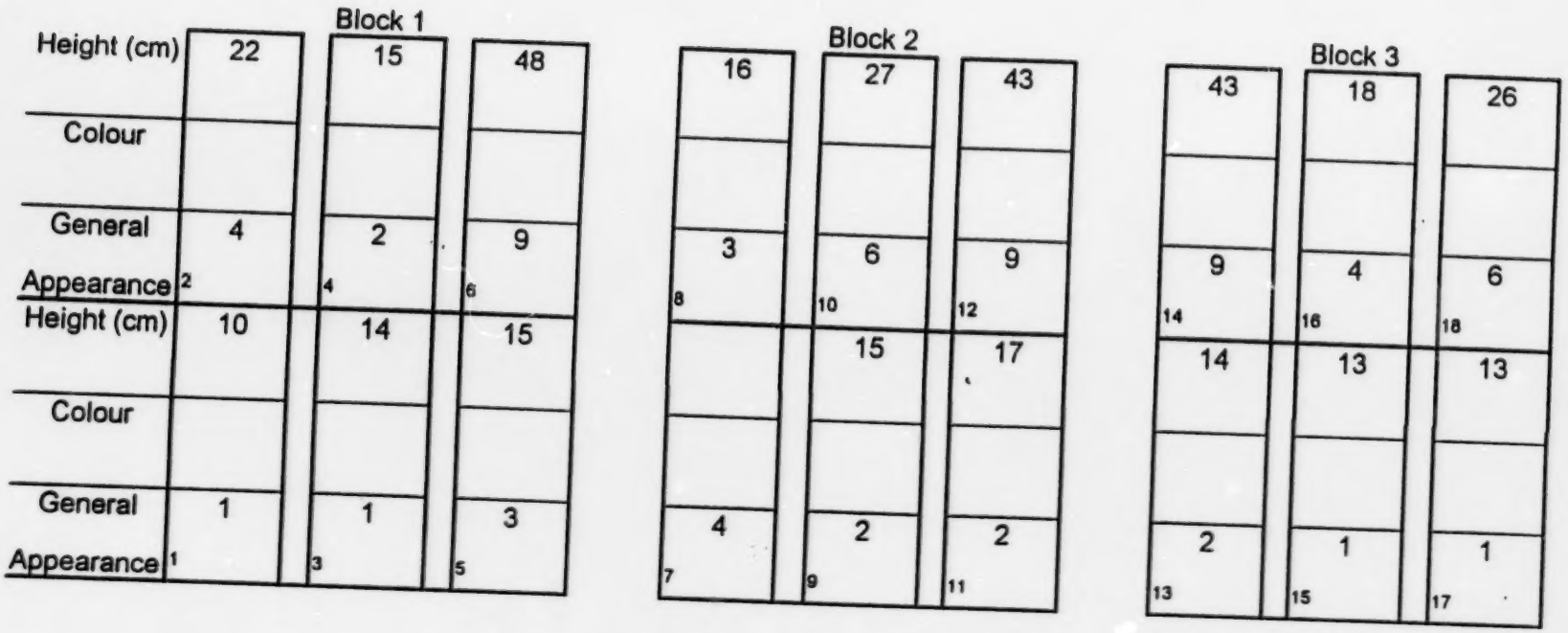
MDFP - Barley/Alfalfa



Ainsworth Strands - Soil #1 (heavy)

Barley/Brome

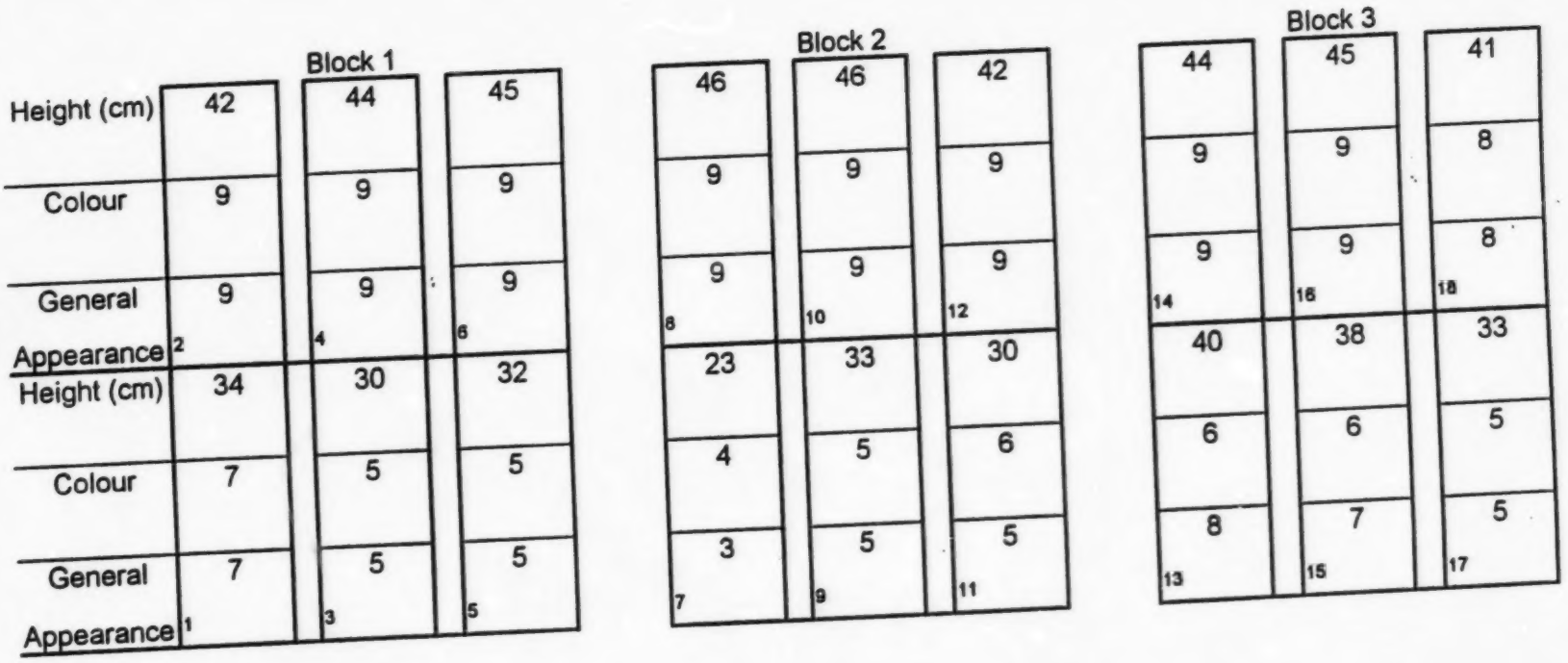
Barley/Alfalfa (a)



Ainsworth Sawdust - Resin - Soil #1(heavy)

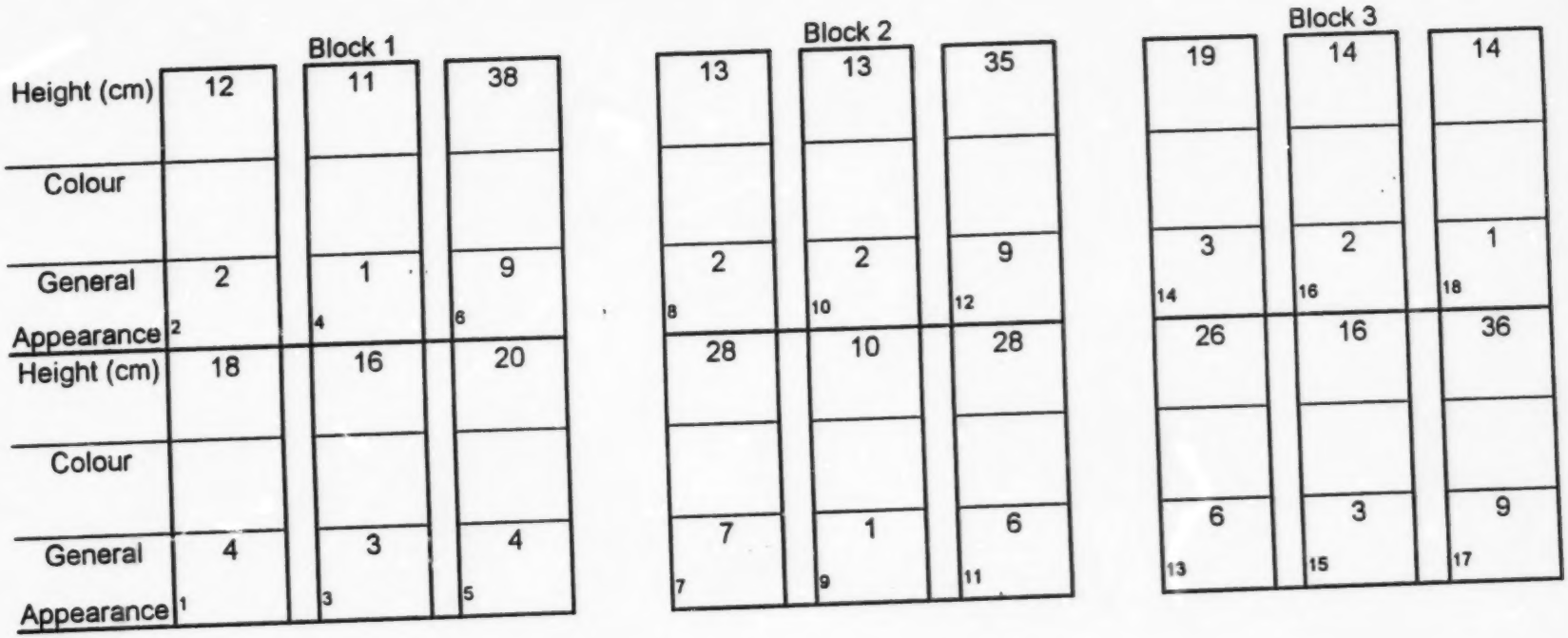
Barley/Brome

Barley/Alfalfa (a)



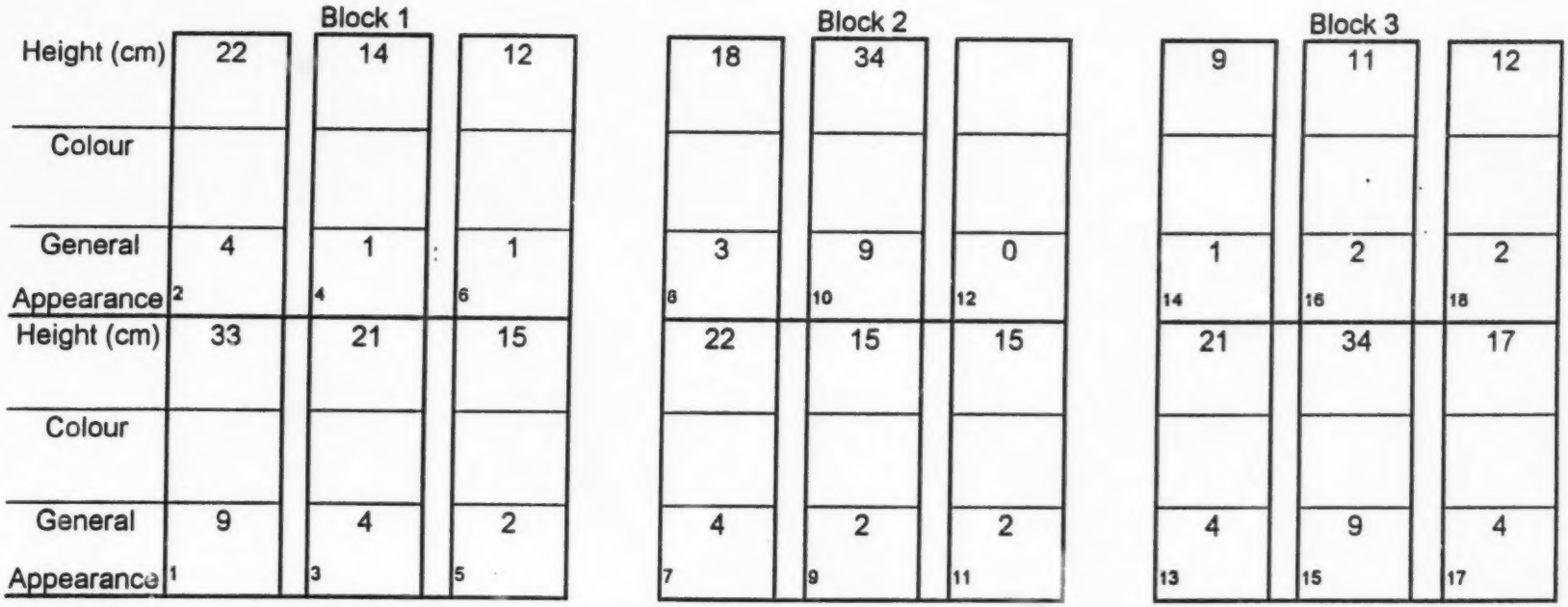
Ainsworth Ash - Soil #1(heavy)

Barley/Brome
Barley/Alfalfa (a)



Ainsworth Strands - Soil #2(sandy)

Barley/Brome
Barley/Alfalfa (a)



Ainsworth Sawdust - Resin - Soil #2(sandy)

Barley/Brome

Barley/Alfalfa (a)

	Block 1		
Height (cm)	22	30	36
Colour	3	5	7
General Appearance	3 (2)	5 (4)	8 (6)
Height (cm)	28	27	34
Colour	5	5	7
General Appearance	5 (1)	5 (3)	8 (5)

Block 2		
35	35	32
8	8	7
8 (8)	8 (10)	7 (12)
40	44	34
7	9	5
8 (7)	9 (9)	5 (11)

Block 3		
44	47	48
9	9	9
9 (14)	9 (16)	9 (18)
33	42	47
4	8	9
5 (13)	8 (15)	9 (17)

Ainsworth Ash - Soil #2(sandy)

Barley/Brome

Barley/Alfalfa (a)